Exfoliation, deposition and functionalization of MoS_2 flakes

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Layered materials are defined as solids with strong in-plane chemical bonds but weak out-of-plane van der Waals interactions, which makes them easy to exfoliate.[1]

Among these materials, transition metal dichalcogenides (TMDCs) stand out due to their broad spectrum of electronic properties based on a large variety of compositions and polytypes. They consist of parallel MX_2 layers (M: metal atom of groups 4-10; X: chalcogen atom) that stack one on top of the other. Each one of these parallel slabs is formed by hexagonal planes of M atoms sandwiched between two planes of X atoms.[2]

In this scenario, MoS_2 is the most studied TMDC due to its electronic, optical, catalytic and lubricant properties. Apart from that, MoS_2 monolayers exhibit intriguing properties because of the quantum size effect, such as the strong photoluminescence, direct bandgap (~1,8 eV) and relatively high mobility rate.[3]

The objectives of this work are the following: (1) optimization of the chemical exfoliation of bulk MoS_2[4] and of the homogeneous deposition of the obtained MoS_2 flakes onto substrates and (2) the functionalization of these flakes with bistable molecular based materials, in order to add new properties to the original MoS_2 ones even with a synergic effect. Thanks to the bistabilitity of the molecular material, we want to tune the influence of this functionalization by external stimuli.

Currently, we are working on the non-covalent functionalization of MoS_2 flakes with Prussian Blue (PB) (**Fig. 1)** which shows ferromagnetic order under external magnetic fields at low temperature.

References

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[3] Liu, P.-F.; Zhou, L.; Frauenheim, T.; Wu, L.-M., Nanoscale, 8 (2016) 4915-4921
[4] Voiry, D. *et al.*, Nat. Chem., 7 (2014) 45-49

Figures

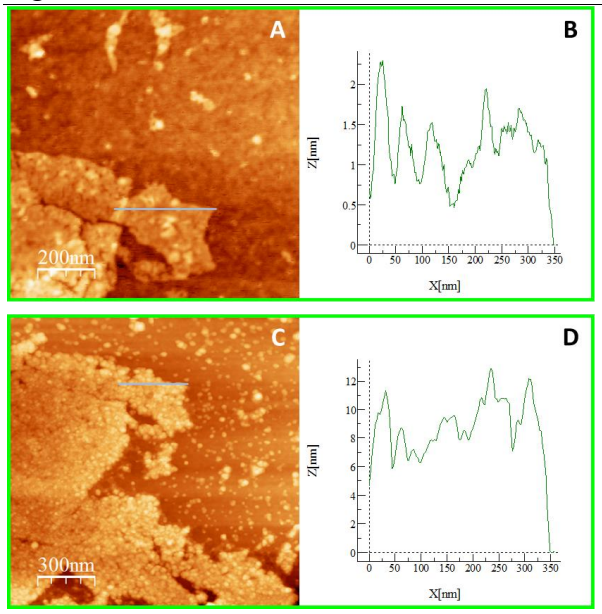

Figure 1: AFM images (A,B) and height profiles (B, C) of MoS_2 flakes on SiO2/Si substrate before (top) and after (bottom) functionalization with PB.